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10/535,346	10/03/2005	Tadashi Ishikawa	52433/797	7148

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KENYON & KENYON LLP
ONE BROADWAY
NEW YORK, NY 10004

EXAMINER	
SHEVIN, MARK L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/535,346	ISHIKAWA ET AL.	
	Examiner	Art Unit	
	MARK L. SHEVIN	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 September 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 7-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5, 7, and 14* is/are rejected.

7)☒ Claim(s) *8-13* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application.
6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

1. Claims 1-5 and 7-14, filed September 16th, 2009, are currently under examination. Claims 1-2 are amended, claim 6 is canceled, and claims 7-14 are new.

Status of Previous Rejections

2. The previous rejections of claims 1-5 under 35 U.S.C. 103(a) over **Statnikov** (US 6,338,765) in view of **Lu** (Nanocrystalline metals...) and **Wang** (Mechanical and electrochemical behavior...) in the Office action dated April 14th, 2009, have been maintained and expanded to reject new claim 7.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. **Claims 7 and 14** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 7, the instant claim mentions "one or more of said plurality of different directions" it is not clear if the vibrations of the indenters of claim 7 are limited to only those directions present in claim 1 (i.e. no "upward directions" relative to the steel surface) or if "said plurality of different directions" may include upward motion, meaning the more general, any number of directions. However, this is interpreted as meaning that one or more indenters moves in more than one direction.

Regarding claim 14, the term "sufficiently lower than the recrystallization temperature" in claim 14 is a relative term which renders the claim indefinite. The term "sufficiently lower" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The boundaries of the claim could be clarified by simply omitting "sufficiently" and just stating that the temperature is made to be "lower than the recrystallization temperature of the steel".

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 103

4. **Claims 1-5, 7, and 14** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Statnikov** (US 6,338,765) in view of **Lu** (K. Lu, Nanocrystalline metals crystallized from amorphous solids: nanocrystallization, structure, and properties, *Materials Science and Engineering*, R16 (1996) p. 161-221.) and **Wang** (X.Y. Wang and D.Y. Li, Mechanical and electrochemical behavior of nanocrystalline surface of 304 stainless steel, *Electrochimica Acta*, 47, (2002), p. 3939-3947.)

Regarding claims 1 and 2, Statnikov teaches a method of subjecting the surface layer of a metallic product (steel, bronze, welded bodies, see Abstract) to ultrasonic impact treatment (column 5, lines 23-40). Statnikov teaches that amorphous "white layers" **(claim 2)** are desirable and may be formed on the surface of a product depending on ultrasonic impact treatment parameters. These "white layers are formed

on the treated body surface" (column 7, line 5) and are substantially devoid of grain structure and therefore amorphous (column 7, lines 20-31). Lastly Statnikov teaches that these white layers are desirable because they provide higher fatigue and corrosion resistance along with higher load carrying ability due to redistributed residual stresses (column 7, lines 25-31).

With respect to the amendment to claim 1 featuring "...by impacting it at a plurality of different direction using one or more ultrasonic indenters...", Statnikov teaches that his ultrasonic transducer head **20** (holding one or more ultrasonic indenters) is moved in a desired scanning pattern **24** over the exterior body surface and this is considered to read on impacting "at a plurality of different directions" as the indenters will have a horizontal component relative to the workpiece surface due to the scanning action as well as a vertical component due to the up and down vibration of the ultrasonic indenters mounted in the transducer head **20**.

Statnikov does not teach step 2, heat treatment to precipitate nanocrystals.

Lu teaches heat treatment as a basic principle for crystallizing ultrafine crystallites, in particular nanocrystals. The crystallization kinetics can be controlled by optimizing the heat treatment conditions including annealing temperature and time (p. 163, para 2, lines 1-4, claim 6). Lu also teaches that nanocrystalline materials often have superior mechanical properties compared to larger grained polycrystalline materials and amorphous materials in terms of ductility, strength, hardness, and diffusivity (p. 161, para 1, lines 6-12).

Lu does not, however, teach the temperature and time for a heat treatment to cause the precipitation of nanocrystals.

Wang, drawn to studies of the nanocrystalline surface layer of steel produced by an analogous severe plastic deformation route (sand-blasting compared to ultrasonic peening), teaches the nanocrystallization of the surface layer resulted in enhanced mechanical properties and improved corrosion resistance (Abstract). Annealing the nanocrystalline layer formed after sandblasting at 350 °C for 60 minutes both increased hardness (Table 2) and increased corrosion resistance and passivation film performance (p. 3943, col. 1, para 2 and Table 3).

It would have been obvious to one of ordinary skill in the metallurgical arts at the time the invention was made to combine Statnikov, Lu, and Wang to produce nanocrystalline surface layers through ultrasonic impact treatment and subsequent heating as Statnikov taught that the amorphous white layers were a product of ultrasonic impact treatment and Lu taught that in general an amorphous microstructure can be converted to a nanocrystalline structure through an appropriate heat treatment and that nanocrystalline microstructures often impart superior mechanical properties (compared to larger grains polycrystalline and amorphous materials). Wang teaches the formation of a nanocrystallized surface layer on a steel (stainless steel 304) by an analogous severe plastic deformation method and taught that annealing the formed nanocrystallized surface layer in the claimed temperature and time range produces improvements in hardness and robustness of the passivation film.

With respect to the limitation of "with said ultrasonic impact treatment of said surface layer providing equiaxial grains in said surface layer", Wang discloses that his severe plastic deformation process that yields nanocrystalline grains produced roughly equiaxed grains (p. 3940, col. 2, para 3) and Lu further adds that many examples of equiaxed grains formed by nanocrystallization from an amorphous precursor (p. 162, para 3; p. 166, para 4; p. 168, para 3; p. 169, para 3; and p. 189, para 4).

With respect to the heat treatment temperature and time range, Lu teaches both annealing temperature and time to be art recognized, result effective variables in transforming an amorphous microstructure to a nanocrystalline microstructure. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify either of these variables depending the crystallization kinetics and thus final microstructure desired.

Wang then teaches a heat treatment with a temperature and time within the claimed range. From MPEP § 2144.05: In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). In addition, "[A] prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a prima facie case of obviousness." *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003).

Alternatively, it would have been obvious to one of ordinary skill in the art at the time of the invention to choose the instantly claimed ranges through process

optimization, since it has been held that there the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980).

One would be motivated to combine Statnikov in view of Lu and Wang because Lu taught the specifics of how to produce nanocrystalline materials and the advantages of them above amorphous materials while Wang taught a specific heat treatment that is demonstrated to increase hardness.

With respect to the amendment to claim 2 stating that "said ultrasonic impact treatment produces an amorphous state in said surface layer", Wang teaches the formation of a nanocrystallized surface layer on a steel (stainless steel 304) by an analogous severe plastic deformation method and taught that annealing the formed nanocrystallized surface layer in the claimed temperature and time range produces improvements in hardness and robustness of the passivation film.

Regarding claim 3, Lu teaches that mechanical alloying (aka mechanical attrition) is a known way of producing nanocrystalline materials (p. 162, para 3, lines 4-9). Furthermore Lu points out that mechanical attrition (mechanical alloying) have been most commonly employed to produce large quantities of nanocrystalline samples up to now (p. 163, para 1, lines 1-7).

Regarding claim 4, Lu teaches that "[C]ontrolled crystallization of amorphous alloys can be used to obtain partially crystallized materials with nanometer-sized crystallites embedded in the residual amorphous matrix." (p. 164, para 2, lines 1-2).

This crystal structure is advantageous in obtaining excellent mechanical or magnetic properties (p. 164, para 2, lines 2-4).

Regarding claim 5, it would have been obvious to one of ordinary skill in the metallurgical arts, at the time the invention was made, to shield the surface of a metallic material from air during ultrasonic impact treatment as shielding a surface from contact with air during a metallurgical treatment is a well known technique (see W Toman et al, Protective Gases, in *Ullmann's Encyclopedia of Industrial Chemistry*, Wiley-VCH Verlag GmbH & Co, online June 15 2000.) in the metallurgical arts and one would have a reasonable expectation of success in applying this known technique to a new process to avoid oxidation or other contamination as neither the technique nor the process would be altered by the combination.

Regarding claim 7, Statnikov's ultrasonic transducer head has indenters (Fig. 8) that move in an upward direction, and then in a different direction, downwards to impart mechanical work to a workpiece (col. 6, lines 4-20). In this case, up and down are interpreted as different directions.

Regarding claim 14, it would have been obvious to one of ordinary skill in metallurgical arts, at the time the invention was made, to have ensured that the ultrasonic impact treatment is performed at a temperature lower than the recrystallization temperature of the steel workpiece as Lu had taught both annealing temperature and time to be art recognized, result effective variables in transforming an amorphous microstructure to a nanocrystalline microstructure which motivates one to avoid recrystallized grains, and thus stay below the recrystallization temperature as Lu's

teachings with respect to time and temperature only apply if the starting microstructure is amorphous (p. 163, para 5, "Conventional annealing can realize the nanocrystallization in most alloy and element systems providing they are formed into the amorphous state…").

Response to Applicant's Arguments:

5. Applicant's arguments filed April 16th, 2009 have been fully considered but they are not persuasive.

Applicants assert (p. 6, para 2) that Statnikov (US 765) does not teach or disclose subjecting the surface of the steel to impacts at a plurality of different directions using one or more ultrasonic indenters and that there is no disclosure of nanocrystallized surface layers.

In response, with respect to the amendment to claim 1 featuring "…by impacting it at a plurality of different direction using one or more ultrasonic indenters…", Statnikov teaches that his ultrasonic transducer head **20** (holding one or more ultrasonic indenters) is moved in a desired scanning pattern **24** over the exterior body surface and this is considered to read on impacting "at a plurality of different directions" as the indenters will have a horizontal component relative to the workpiece surface due to the scanning action as well as a vertical component due to the up and down vibration of the ultrasonic indenters mounted in the transducer head **20**.

Furthermore, Statnikov teach forming an amorphous surface layer on the workpiece. Statnikov teaches that amorphous "white layers" **(claim 2)** are desirable

and may be formed on the surface of a product depending on ultrasonic impact treatment parameters. These "white layers are formed on the treated body surface" (column 7, line 5) and are substantially devoid of grain structure and therefore amorphous (column 7, lines 20-31). Lastly Statnikov teaches that these white layers are desirable because they provide higher fatigue and corrosion resistance along with higher load carrying ability due to redistributed residual stresses (column 7, lines 25-31).

The rejection of claim 1 above adds that Lu and Wang provide motivation to anneal the surface in the claimed temperature range and for the claimed duration to produce a nanocrystalline layer.

Applicants assert (p. 6, para 3-5) that none of Lu or Wang teach an ultrasonic treatment.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Allowable Subject Matter and Reasons for Indicating

6. Claims 8-13 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

With respect to claims 8 and 10, the closest prior art of Statnikov, Lu, and Wang do not teach or suggest an ultrasonic impact method featuring one or more indenters comprising three ultrasonic indenters where at least one of these indenters present an incident angle to the workpiece of 30° or more.

With respect to claims 9, 11, and 12, these references also do not teach or suggest that the three indenters are arranged at 120° from each other.

With respect to claim 13, these references also do not teach or suggest indenters that turn or rock during ultrasonic impact treatment.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

-- Claims 1-5, 7, and 14 are finally rejected
-- Claims 8-13 are objected to
-- No claims are allowed

The rejections above rely on the references for all the teachings expressed in the texts of the references and/or one of ordinary skill in the metallurgical art would have reasonably understood or implied from the texts of the references. To emphasize certain aspects of the prior art, only specific portions of the texts have been pointed out. Each reference as a whole should be reviewed in responding to the rejection, since other sections of the same reference and/or various combinations of the cited references may be relied on in future rejections in view of amendments.

All recited limitations in the instant claims have been met by the rejections as set forth above. Applicant is reminded that when amendment and/or revision is required, applicant should therefore specifically point out the support for any amendments made to the disclosure. See 37 C.F.R. § 1.121; 37 C.F.R. Part §41.37 (c)(1)(v); MPEP §714.02; and MPEP §2411.01(B).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark L. Shevin whose telephone number is (571) 270-3588 and fax number is (571) 270-4588. The examiner can normally be reached on Monday - Friday, 8:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy M. King can be reached on (571) 272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

/Mark L. Shevin/
Examiner, Art Unit 1793

December 29th, 2009
10-535,346

/George Wyszomierski/
Primary Examiner
Art Unit 1793